a most important part of the main groundwork of its organisation, is not in the least theoretical in its character. Its possible development has suggested itself to many who have given thought to the future sphere of action of the Institute in connexion with commerce and industry; to myself, who for many years have been, from time to time, officially cognisant of the work performed by what are called the Intelligence Departments of the Ministries of War abroad and at home, the direct and valuable bearing of such a system upon the work of the Institute, suggested itself as soon as I gave thought to the possible future of this great conception, and to Major Fitzgerald Law belongs the credit of suggesting that the well-tried machinery of the War Office Intelligence Department should serve as a guide for the elaboration of a Commercial Intelligence Department. This Department, which will, it is hoped, ere long commence its operations by establishing relations with the chief colonies and India, will be in constant communication with the Inquiry Offices to be attached to the local commercial establishments and to other provincial representations of the work of the Institute, systematically distributing among them the commercial information and statistics continually collected. It will be equally valuable to the colonies and India by bringing their requirements thoroughly to the knowledge of the business men in the United Kingdom, and by maintaining that close touch and sympathy between them and the people at home which will tend to a true federation of all parts of the Empire.

In no more important direction is this system destined to do useful work than in the organisation of emigration, not only of labour, but also of capital. The establishment of emigration inquiry offices at provincial centres in connexion with a central department at the Institute, will be of great service to the intending emigrant, by placing within his reach the power of acquiring indispensable information and advice, and by facilitating his attainment of the special knowledge or training calculated to advance his prospects in the new home of his choice. Similarly, the capitalist may be assisted in discovering new channels for enterprise in distant portions of the Empire, the resources of which are awaiting development by the judicious application of capital and by the particular class of emigration which its devotion to public works or manufacturing enterprise in the Colonies would carry with it. The extent to which the State may aid in the organisation of systematic emigration, and the best mode in which it may, without burden to the country, promote the execution of such public works in the Colonies as will open up their dominions to commerce and at the same time encourage the particular class of emigration most advantageous to the Colonies themselves, are subjects of great present interest; but, in whatever way these important questions may be grappled with, such an organisation as the Institute should supply cannot fail to accelerate the establishment of emigration upon a sound and systematic footing, and to co-operate very beneficially in directing private enterprise into the channels best calculated to advance the mutual interests of the capitalists and the colonies.

I have already indicated that it is not only in connexion with purely commercial matters that the Intelligence Department of the Institute will occupy itself. The prospects of its value to the Colonies and to India in promoting the development of their natural resources and the cultivation of new fields for commercial and industrial activity are well illustrated by the valuable work which has been accomplished upon similar lines by the admirably directed organisation at Kew.

By the systematic collection and distribution of information relating to industries and to education from all countries which compete with ourselves in the struggle for supremacy in intellectual and industrial development, the Institute will most importantly contribute to the maintenance of intimate relationship and co-operation between educational, industrial, and commercial centres, between the labourer in science and the sources through which his work becomes instrumental in advancing national prosperity; between the Colonies and the Mother Country, between ourselves and all races included in the vast Empire of Her Majesty.

In conclusion, I venture to express the belief that the organisation which the Imperial Institute will have the power of developing, with a wisely constructed governing body at its head, may accomplish, and at no distant date, other most useful work, which has been already publicly indicated as destined to have an immediate bearing upon the federation of England and her colonies. Prof. Huxley, in his last Presidential Address to the Royal Society, uttered most suggestive words, indicative of the value and the possibility of a *scientific* federation of all English-speaking peoples; and this subject is now receiving the careful consideration of that Society. It is firmly believed by leading men of science that such a federation of at any rate the Colonies and Dependencies with us will be brought about, and it is in harmony with that belief that the Imperial Institute should be expected, through its organisation, to afford important aid in the application of the principle of federation to the geological and topographical survey of the Colonies, in the establishment of a system of interchange of meteorological and scientific observations, and in the promotion, in various ways, of thorough co-operation between particular Colonies, or groups of Colonies, for applying the results of scientific research to the mutual development of their natural resources.

It may be that the programme of which I have given a very imperfect exposition, as indicative of the work which the Imperial Institute may be called upon to accomplish, will be regarded by some as almost too ambitious in its scope for practical fulfilment. The outline of this programme has been drawn by a combination of abler hands than mine; I have but ventured to sketch in some of the details as they have presented themselves to my mind, and to the minds of others who have given thought to this great subject; but I dare to have faith in its realisation, and to believe that, if the work be taken in hand systematically and progressively, the nucleus being first thoroughly established from which fresh lines of departure will successively emanate, the Imperial Institute is destined to become a glory of the land. And, as one whose mission it has been, through many years of arduous work, to assist in a humble way in the application of the resources of some branches of science to the maintenance of the country's power to defend its rights and to hold its own, I may perhaps be pardoned for my presumption in giving expression to the firm belief that, by the secure foundation and careful development of this great undertaking, and by its wise direction, by a government truly representative of its founders—all Nations and Classes composing the Empire—there will be secured in it one of the most important future defences of the Queen's dominions; one of the most powerful instruments for the maintenance of the unity, the strength, and the prosperity of her realms.

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## *THE LOCOMOTOR SYSTEM OF STAR-FISH.*

PROF. PREYER, of Jena, has recently concluded an elaborate research "Ueber die Bewegungen der Seesterne." This paper, which contains over thirty illustrations, appears in the Publications of the Zoological Station at Naples (vii.), where the investigation was carried on during a period of nearly five months. This investigation was exclusively physiological, and confined to the star-fish—the Holothurians, Echini, &c., not having fallen within its scope. Considering that Prof. Preyer thus selected a line of experimental inquiry which had been already pretty well worked out, he deserves to be congratulated on the everywhere interesting and frequently novel character of his results. The most important of these results, in so far as they are new, appears to me—as also to himself—to be his demonstration that a severed ray of a star-fish exhibits much more co-ordination in the management of its tube-feet, if the section has been arranged so that two or more of the central ganglia in the disk are left in connexion with the ray, than if only one of these ganglia be so left. It was previously known that under any circumstances the severed ray of a star-fish would not only crawl about, seek the light, &c., but also right itself when turned over on its back. In order to execute this manœuvre highly co-ordinated action on the part of the tube-feet is required, and therefore the interest attaching to Prof. Preyer's observation consists in its having shown that this co-ordination cannot be nearly so well effected by one of the central ganglia as it can be by two or more of them. Or, in his own words, "Also leisten 2 functionell gleichwerthige Theile des Nervensystems zusammen qualitativ mehr als jeder für sich. Man kommt auf die Vermuthung, dass auch bei den höheren Thieren, und vielleicht auch dem Menschen, es nicht allein die qualitative Beschaffenheit der Ganglienzellen, sondern auch ihre Anzahl und Verbindung ist, welche höhere psychische Leistungen ermöglichen."

Highly interesting also are the results of numerous ingenious experiments devised with a view of testing whether the adaptive movements of star-fish can be explained as due to mechanical reflexes alone, or require us to suppose something of the nature

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of a rudimentary intelligence. These experiments consisted in placing the animals in various unnatural circumstances, and observing the means which they adopted in order to extricate themselves. For instance, a piece of narrow tube was pushed over one of the rays of a brittle-star, so as to tightly inclose that ray from its base to within an inch or two of its apex. In order to get rid of such an obstruction the star-fish did not always adopt the same method, as we should have expected if the adaptive actions were of a purely reflex kind. Sometimes they rubbed the tube off by friction on the ground; but if the tube were too closely fitting to admit of this mode of removing it, they would adopt sundry other devices—such as holding the tube firmly down by the other rays while drawing the imprisoned ray through its cavity; or by means of the serrated edges of the two adjacent rays progressively pushing the tube upwards over the end of the imprisoned ray; or, lastly, failing every other means, by amputating the imprisoned arm. Various other experiments were tried in the way of pinning down the star-fish in unnatural positions, and the expedients to which they resorted in order to regain their liberty appeared to Prof. Preyer amply to prove the presence in them of psychical as distinguished from merely physiological functions.

Although these are the results of most importance, many others are full of interest to the working physiologist. To me individually this is especially the case, seeing that the research has everywhere proceeded upon the same lines as those which Prof. Ewart and myself adopted while working out the physiological part of our inquiry concerning the locomotor system of Echinodermata. It is satisfactory to note that in almost every particular Prof. Preyer has corroborated our results. There are, however, four or five points—mostly of subordinate importance—with regard to which he expresses disagreement with these results. I have, therefore, carefully considered these points, and have come to the conclusion that the discrepancies admit of being explained, either (1) by our not having worked with the same species of star-fish; (2) where we did work with the same species, by our not having employed precisely the same methods of stimulation; or (3) by the temperature of the water at Naples being higher than that with which we worked in the north of Scotland. This explanation refers to the few, and comparatively unimportant, disagreements upon matters of fact. But Prof. Preyer's principal disagreement with us is upon a matter of inference. He objects to our over-caution in expressly refusing to credit the Echinodermata with any psychical faculties, remarking that many of our own results are sufficient to show that there must be something more than simple reflex mechanism concerned in the adaptive movements of these animals. Here, however, Prof. Preyer has misunderstood our meaning. We did not "expressly declare" that the star-fish are destitute of any psychical faculty: we merely excluded the question from our paper as one very difficult to answer, and as not strictly appertaining to a physiological research. But if Prof. Preyer will turn to a subsequent publication of my own, where this question does require to be considered, he will find that my views upon the subject are in very much closer agreement with his than he at present supposes.[1] Indeed, although I am perhaps less confident in attributing to them any psychical faculties other than that of a short-lived memory (which I argue admits of being proved), I think that the level in the psychological scale to which I do assign them in my book is just about the level to which, in his opinion, they ought to be assigned.

It only remains to add that for my own part I hope Prof. Preyer will next extend his researches to the Echini, which present even more abundant material for physiological investigation than the star-fish, and out of which, therefore, his observant mind may be expected to evolve even more interesting results.

George J. Romanes.

## THE REPORT OF THE SELECT COMMITTEE ON ENDOWED SCHOOLS.

During the present week the Report of the Committee, to the main results of which we were able to refer in our last issue, has been printed. It is a document of first-rate importance. Reserving a more detailed examination of some parts of it for a future occasion, we give this week an extract from the general conclusion of the Report, and also a summary of some of the opinions formed, and recommendations made.

### *Conclusion.*

A pressing need now seems to be that we should not forget, in the search for more immediate advantages of an obvious nature, the importance of preserving, even at some cost, a high ideal of secondary education, both on its own account and in its connexions either with the Universities or with the excellent Colleges which have been recently established in our large towns with the special object of education in relation to the needs of manufacturing and commercial communities. Your Committee find that the work done by the Charity Commissioners under the Endowed Schools Acts, while it has not lost sight of this ideal, has done much to bring higher instruction, in popular and necessary forms, within the reach of classes which otherwise would have been shut out from it. It has thus fulfilled a double function: to promote in all classes the creation of trained intelligence, and to build up a system under which, when created, it may find a free and prosperous scope. With such improvements as your Committee have recommended in future schemes, it is to be hoped that the intelligence of the working-classes will be trained in a direction which, while it develops their intellectual faculties, will at the same time enable these faculties to be more readily applied to the needs of productive industry.

### *Summary.*

The great extension in elementary education under the Education Acts having, to a certain extent, altered the position and objects of elementary endowed schools, in any scheme for remodelling them, special attention should be directed to providing, as far as possible, for the children of the working-classes a practical instruction suitable to their wants in the particular circumstances of each locality.

The policy of the Commissioners has been to establish scholarships in elementary schools and exhibitions from them to schools of secondary education. On the whole these have worked well in large towns, but they are less adapted to the circumstances of a scattered rural population; and in any case scrupulous care should be taken where endowments have been appropriated to the poor, that the paramount interests of the poor should be secured in the application of scholarships or exhibitions provided out of the trust funds.

The abolition of gratuitous education in elementary endowed schools is generally opposed to the wishes of the poorer classes in the localities. It is only justifiable when the imposition of fees gives a higher and more useful character of education to the working-classes than they formerly enjoyed, and after provision made for payment of school fees of children whose parents stand specially in need of such assistance.

The application of non-educational endowments to educational purposes under Section 30 of the Act of 1869 has been beneficial, but the veto now possessed by the trustees of such endowments is, in some cases, a hindrance to reforms and an inadequate protection for the poor. It would be expedient to substitute, for the consent of the trustees, the concurrence of some local representative body.

The diversion of educational endowments from one locality, decreasing in population, to a neighbouring populous locality, is sometimes necessary, but should only take place after the requirements of the locality have been met.

The diversion of an endowment, partially or entirely, from the education of boys to that of girls, has been successful in numerous instances, but when opposed by the localities it requires discretion in its exercise.

The extension of technical and higher commercial education has risen to much importance since the Act of 1869, and should be carefully kept in view by the Commissioners in framing their schemes. When the value of the endowment is too small to provide laboratories and workshops for technical or scientific teaching, the local authorities might be empowered to initiate and aid them by local rates. But before applying local rates in aid of technical or scientific teaching, endowments, the purposes of which have failed, should, as far as practicable, be utilised.

The examination of endowed schools and inspection of the state of the buildings and apparatus, and of the discipline and general working, are subjects of urgent importance. Reports upon the actual condition of the schools should be periodically laid before Parliament. Those reports should be published in the locality in a cheap and convenient form.

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[1] "Mental Evolution in Animals," pp. 76. 342, 348-49.

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